Research Article

Changes in Knowledge, Beliefs, and Behaviors Following a Remote Diabetic Education Session Among Adults Living with Diabetes in a Rural Community

Mary Sheerin, RDN

Introduction

The incidence of Type 2 diabetes has been a rising concern for Americans since 1994.[1] According to the CDC, in the last 20 years, the number of adults diagnosed with diabetes has more than doubled as the American population has aged and become more overweight or obese. Of the confirmed diagnoses of diabetes, type 2 diabetes accounts for approximately 90-95% of cases.[2] The increasing statistics are alarming and point towards the inadequacies of the public health approach to treat and prevent the disease.

Health services are struggling with the morbidity, mortality, and costs associated with the complications of this long-term condition.[3] Diabetes Self-Management Education and Support (DSMES) services have been shown to have a positive impact on lifestyle changes, such as eating patterns and activity levels, ultimately leading to a decrease in hemoglobin A1c levels, prevention or delay of diabetes complications, and improved quality of life.[4] In addition, DSMES services have been shown to be cost-effective by reducing hospital admissions and readmissions, as well as estimated lifetime health care costs related to a lower risk for complications.[5] According to the Centers for Disease Control and Prevention (CDC), the annual

cost for diabetes in the United States is an estimated $327 billion dollars due to increased medical costs and lost wages.[4]

The consensus recommendation from the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) is that all people with type 2 diabetes should be offered access to ongoing DSMES programs.[6] These programs are typically led by a diabetes educator such as a registered nurse, registered dietitian, or pharmacist. They are guided by evidence-based standards and teach the individual how to eat healthy, be physically active, monitor blood sugar levels, take medication, problem solve, reduce risk for other health conditions, cope with the emotional side of diabetes, and improve health and quality of life.[7]

Barriers to attending DSMES include inconvenience, fear of stigma, and lack of knowledge about the potential benefits.[3] One of the most important aspects of these programs is that they can be implemented in alternative settings, such as telehealth. The Health Resources and Services Administration (HRSA) defines telehealth as "the use of electronic information and telecommunications technologies to support long-distance clinical healthcare, patient and professional health-related education, public health, and health administration".[9] The availability of a DMSES service via telehealth may help overcome challenges associated with attending education sessions in person; they have the potential for delivery at multiple locations at convenient times, anonymity, and presentation of content in an attractive format.[3]

United Health Services (UHS) in New York State offers in-person diabetic teaching classes in the form of a DSMES service. To date, there is no official educational program for patients unable to attend in-person diabetic teaching classes within the UHS hospital system. A needs assessment was conducted in October, 2021 and identified a rural population in need of

formal diabetes education as they are unable to attend in-person classes. The purpose of this study is to evaluate any changes in knowledge, behaviors, and beliefs of the rural population after have completed a remote diabetes education session over the telephone with the primary researcher. The results of this study will be used to decide whether the development of a formal nutrition education program via telehealth would benefit those unable to attend in-person diabetes teaching classes at UHS.

Methods

Study design

A quasi-experimental design was used in this study. Pre-test data was assessed and compared to post-test outcomes among the rural individuals willing to participate in the study. Prior to the intervention, the participants completed a questionnaire with the primary researcher over the telephone. The intervention comprised of an education session that lasted approximately 30 minutes and was conducted over the telephone as well. After the intervention was completed the participants were presented with the same questionnaire approximately 1 week later. Additional data was collected to assess effectiveness of the intervention and included a 24-hour dietary recall, weight, BMI and hemoglobin A1c. The project was approved by the SUNY Oneonta Institutional Review Board.

Participant Recruitment

Participants were recruited by a registered nurse on the population health team at UHS using the inclusion criteria set by the researcher. Inclusion criteria included hemoglobin A1c (HbA1c) >8.0%, type 2 diabetes diagnosis, ability to read/write in English, and access to a phone and/or computer with internet access and email. The qualified individuals who met the inclusion criteria were asked if they wanted to participate in the intervention and then asked for oral consent over the phone (n = 4). Participants were between ages 51 and 65 years old and all but one was male. The highest education level was a master's degree while the lowest was 12th grade.

Intervention

The intervention was based off the existing Diabetes Self-Management Education Program offered at the UHS Diabetes and Endocrinology Center, in that it included lifestyle and meal planning education. The researcher created an educational handout that was reviewed with each individual separately over the telephone, and then provided electronically via email. The education was completed in one session that lasted approximately 30 minutes. The education content included information on carbohydrate counting, the Diabetes Plate Method, physical activity, and the glycemic index. The course objectives were to improve knowledge, beliefs, and behaviors towards ways to optimize blood sugar control via diet and exercise. This education was based off the adult learning theory, andragogy, which was a concept popularized by Malcolm Knowles in 1980 and means the "art and science of helping adults learn".[9]

Tools

Survey items used in the evaluation were developed based off two existing validated questionnaires. The pre- and post-course questionnaires consisted of the same material and included 12 multiple-choice and 2 fill-in-the-blank questions covering disease management, menu planning, and physical activity.

Knowledge, confidence, and importance of using diet and lifestyle to better control diabetes were assessed using multiple-choice questions with answers ranging from “not knowledgeable at all; not confident at all; not at all important” to “very knowledgeable; very confident; very important”. More specific menu planning questions included the concept of carbohydrate counting and implementing the Diabetes Plate Method. One of the fill-in-the-blank questions assessed knowledge of the Diabetes Plate Method, while the remaining fill-in-the-blank questions inquired about barriers related to exercise and dietary change.

Data Analysis

The focus of the data analysis was to determine whether there was a significant change in course participant questionnaire responses, HbA1c or BMI following the intervention portion of this study. Qualitative and quantitative data were stored in a Microsoft Office database. Due to small sample size (n=4), a Wilcoxon Rank-Sum Test was used to compare differences in pre- and post-test survey scores as well as changes in HbA1c and BMI. The statistical analysis was

done using SPSS Statistics (version 26). The level for determining statistical significance was $P < .05$ for all comparisons.

Results

Participant demographic data are presented in **Table 1**. The diabetes education intervention included 4 adults ranging from 51 to 65 years old (n=4). The majority of participants were male and achieved some level of higher education. Half of the participants reported that they were employed while the other half were not. The lowest height measured 61", while the tallest reached 77" (SD 6.55). All but one participant met criteria for morbid obesity (BMI > 40).

Table 1. Characteristics of the rural population with type 2 diabetes (n=4)

Characteristic	Mean (SD) / Mean (%)*
Age (y)	57.75 (6.8)
Height (in)	69.25 (6.55)
Weight (lbs)	333.88 (105.23)
Employment	
• Yes	2 (50.0)
• No	2 (50.0)
Gender	
• Male	3 (75.0)
• Female	1 (25.0)
Education	
• High School	1 (25.0)
• Associates	1 (25.0)
• Bachelor's or Master's	2 (50.0)

*Continuous data are expressed as means (SD) and categorical data are expressed as n (%).

Qualitative Data Analysis

Qualitative data were thematically examined to identify barriers related to exercise and dietary change. Descriptive subthemes were created around main topics to help group data and identify emergent themes. **Table 2** shows the grouped data along with the number of participant responses and the quoted answers from the questionnaire. Participants were also asked about their knowledge of the Diabetes Plate Method during the initial survey and all four individuals responded "unsure" (n=4). When provided with the post-test, all four participants were able to explain the Diabetes Plate Method correctly and reported using the plate method a few times per week.

The common theme for barriers related to exercise was "physical limitation", while the most common theme for dietary change was "none", meaning there was no barrier. If looking at the question as a whole, the most common themes listed were "work" and "physical limitation". Coding decisions were discussed by 2 members of the research team and revised until agreement was reached.

Table 2. Barriers toward exercise and dietary change.

Subthemes for Exercise	**Number of Participant Responses (n)**	**Response**
• Work • No facility access • Physical limitation	1 1 2	1. "working long hours" 2. "living far away with no gym" 3. "arthritis and obesity" 4. "pain, spinal problem"
Subthemes for Diet	**Number of Participant Responses (n)**	**Response**
• Work • Physical limitation	1 1	1. "working long hours" 2. "lack of mobility"

• None	2	3. “No barrier”

Four survey questions were analyzed via Likert scale. They included information that assessed “how knowledgeable.., how confident.., and how important” the specific topic of diet and lifestyle was in accordance to diabetes and, “how likely” they were to consider starting an exercise regimen to help improve their health and blood sugar control. **Figure 1, 2, and 3** illustrate the total number of responses from all participants (n=4) answering the questions related to diet and lifestyle. In **Figure 1**, all 4 participants reported that they felt “knowledgeable” about using diet and lifestyle to better control their diabetes during both the pre-test and post-test. As shown in **Figure 2** during the pre-test, half of the participants stated that they felt “somewhat confident” in their ability to use diet and lifestyle to better control their diabetes, while the other half stated they were “confident”. At the time of the post-test, all 4 participants stated that they felt “confident”. Lastly, during the pre-test, data in **Figure 3** shows that one person stated it was “important” to use diet and lifestyle to better control their diabetes, while the remaining three stated it was “very important”. During the post-test, all four stated it was “very important”.

Figure 4 shows data related to the question “how likely” each participant was to consider starting an exercise regimen. All but one participant stated that they were “unsure” while the remaining individual selected “likely”. During the post-test, all 4 participants (n=4) selected that it was “likely” that they would start an exercise regimen to help improve health and blood sugar control.

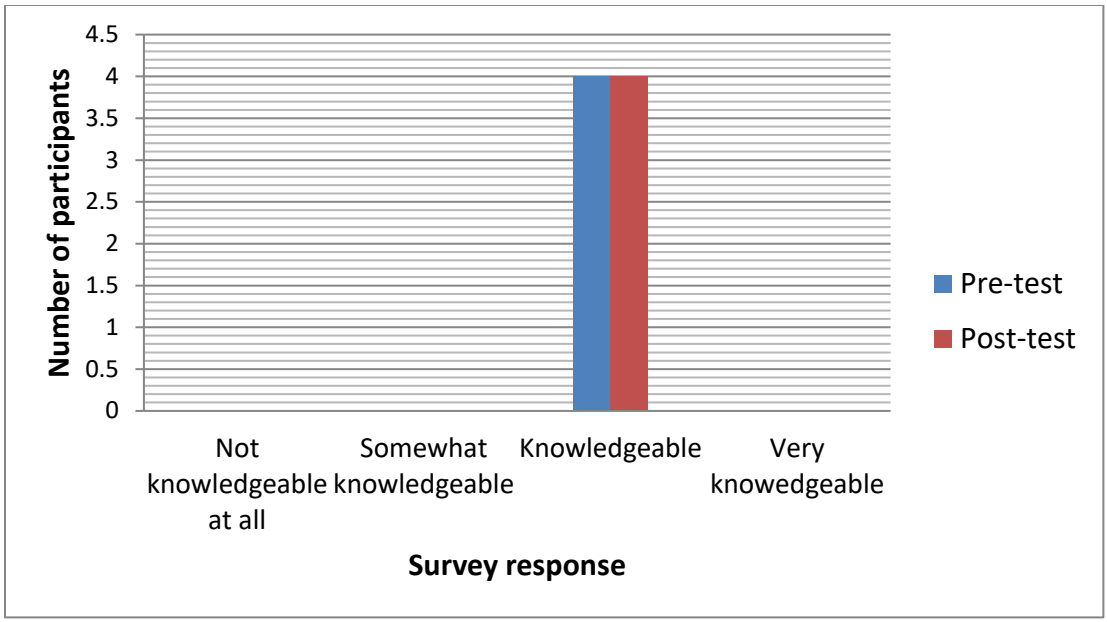


Figure 1. *How knowledgeable do you feel about using diet and lifestyle to better control your diabetes?*

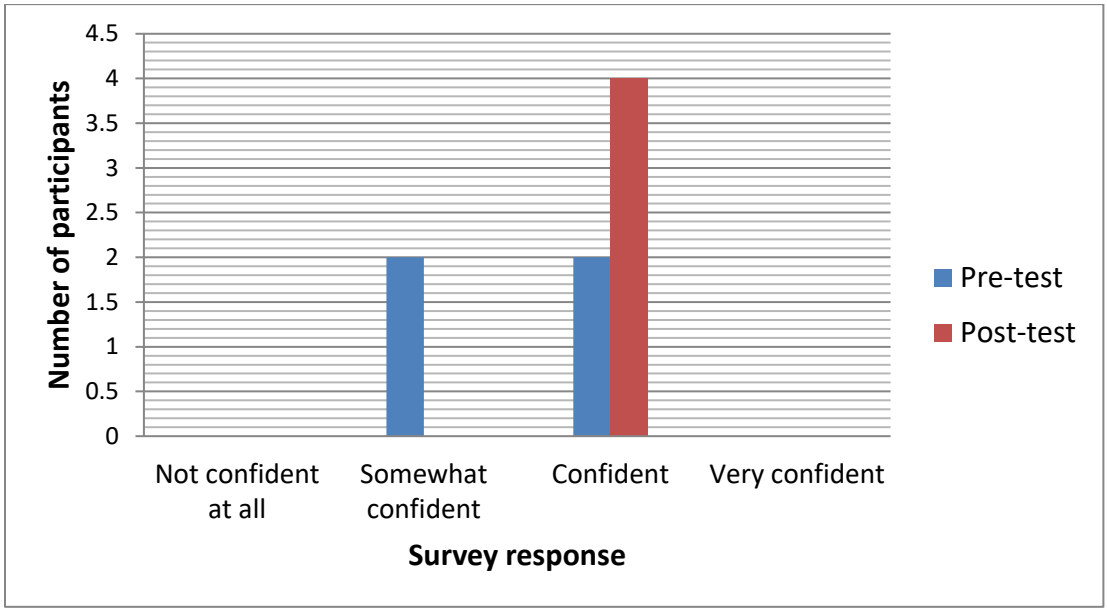


Figure 2. *How confident do you feel in your ability to use diet and lifestyle to better control your diabetes?*

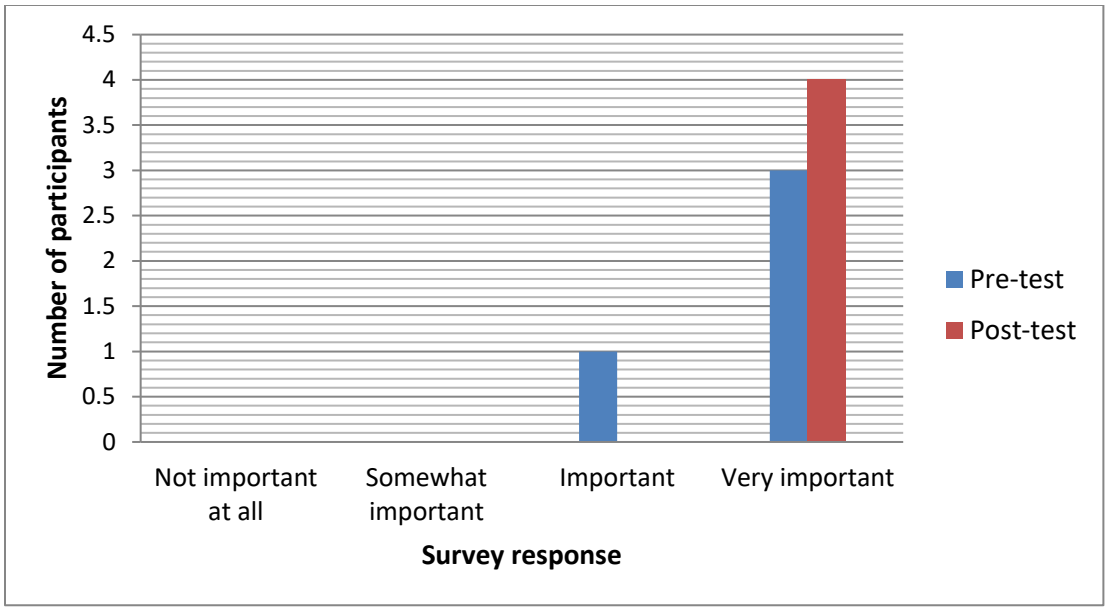


Figure 3. *How important is it to you to use diet and lifestyle to better control your diabetes?*

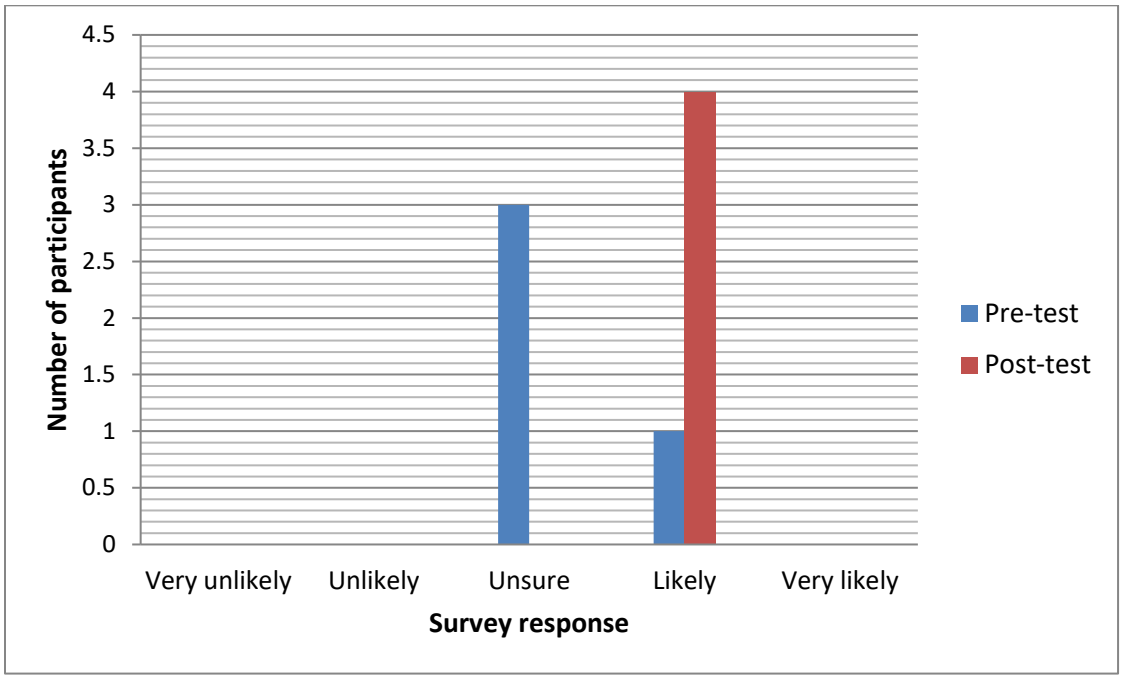


Figure 4. *How likely are you to consider starting an exercise regimen to help improve your health and blood sugar control?*

Quantitative Data Analysis

A Wilcoxon signed-rank test was used for all statistical analysis as neither of the data being assessed had normality. Seven of the 14 questions included in the questionnaire were assessed for statistical significance. **Table 3** shows the descriptive statistics for both the pre-test and post-test. The total number of questions each person could score correctly was 7.0. The minimum number of questions the participants answered correctly during the pre-test was 5.0, while the maximum was 6.0. It appears that participants answered more questions correctly during the post-test as the minimum test score was 6.0 while the maximum was 7.0. Despite this, the diabetes education intervention did not produce a statistically significant change in test scores among individuals with type 2 diabetes who have never received official diabetic education in the past (Z= -1.342, p = .180). The median test score for the pre-test was 6.0, while the median test score for the post-test was 6.5.

Table 3. *Statistical analysis*

Outcome Measure	**n = 4**					
	Scale Range	**Minimum**	**Maximum**	**Mean**	**Std. Dev.**	**P Value**
Pre-Test	0.0-7.0	5.0	6.0	5.750	.5000	
Post-Test	0.0-7.0	6.0	7.0	6.500	.5774	
						.180
				Percentiles		
				25th	*50th (median)*	*75th*
Pre-Test				5.2500	6.0000	6.0000
Post-Test				6.0000	6.5000	7.0000

P < .05

BMI and HbA1c were also tested for statistical significance. The initial weights and HbA1c measurements that were used for analysis were taken between September - November, 2021, while the data used for comparison were obtained January – February, 2022. Due to the short duration between the survey times and intervention, preliminary data was collected as close as possible to the needs assessment portion of this study (conducted October 2021) to assess for any potential influence on diet or lifestyle change. Participants appeared to have lost weight between the time of the needs assessment and the intervention as the mean BMI measurement from 2022 is less than the mean BMI from 2021 (**Table 4**). Although this may seem favorable, there was no significant change in BMI from when the needs assessment was conducted in October, 2021 to the completion of the education intervention in February, 2022 ($p = .854$). The median BMI for 2021 was 53.75, while the median BMI for 2022 was 54.50.

Similar differences are seen among data collected for HbA1c however, only 3 participants had two measurements of HbA1c within the desired time frame, therefore $n = 3$ for this specific analysis. It appears participants had a reduction in their HbA1c after starting this study as the minimum value for HbA1c is lower in 2022 when compared to data in 2021. Again, despite this observation, there was no significant difference in average blood sugar measurement between 2021 and 2022, respectively (**Table 4**). According to the ranks, all 3 participants resulted with a lower HbA1c once tested again in 2022 (data not shown). The median for HbA1c in 2021 was 8.50, while in 2022 the median was slightly lower at 8.30.

Table 4. *Statistical analysis*

Outcome Measure	**n = 4**				**Percentiles**			**P Value**
	Mean	**Std.Deviation**	**Minimum**	**Maximum**	***25th***	***50th (median)***	***75th***	
BMI 9/21-11/21	48.825	11.472	31.70	56.10	37.150	53.750	55.575	
BMI 1/22-2/22	48.750	12.039	30.70	55.30	36.650	54.500	55.100	.854
	n = 3							
	Mean	**Std.Deviation**	**Minimum**	**Maximum**	***25th***	***50th (median)***	***75th***	
HbA1c 9/21-11/21	8.867	.8145	8.30	9.80	8.30	8.50	9.80	
HbA1c 1/22-2/22	8.667	.7234	8.20	9.50	8.20	8.30	9.50	.109

P < .05

Discussion

This study showed that the diabetic education intervention conducted over the telephone did not elicit a statically significant change in test scores, weight, or HbA1c among the participants with type 2 diabetes. Despite observing some data shifts the sample size was simply too small to show any significant change (n = 4; p <.05). An additional limitation of this study was that some of the measurements of BMI and HbA1c were obtained before the intervention took place; therefore, we are unsure if the intervention even had an impact at all. In order to accurately assess for potential dietary change using biometric data, such as HbA1c, the researcher would need to obtain an HbA1c measurement before the diabetic intervention, and again 3 months after. One strength noted was that we were able to match each respondent to their pre/post-test data using a coded numbering system to maintain confidentiality. This

allowed us to assess how each individual scored and changed in ways of physicality and biometric data.

There was an overall positive reflection on this research study based off feedback from the participants. Their baseline knowledge of diabetes and lifestyle management was moderately intact; however, it was barriers such as time and physical limitations, like obesity, that held them back from progressive change. Responsibility for successfully managing diabetes cannot lie on healthcare professionals alone, it requires the co-sharing of responsibility between patients and other necessary health professionals.[10] There is emerging science on diabetes and technological breakthroughs when it comes to delivering education. Diabetes self-management education (DSME) becomes a very important component of diabetes care because it provides a foundation to help people navigate their decisions and activities in view of their chronic condition.[10] These programs have been shown to enhance patient outcomes in terms of reducing mortality and complications, and improving quality of life through lowering HbA1c levels, having better control of blood pressure and weight management, and successful implementation of lifestyle changes.[10]

Although this study did not use sophisticated technology to conduct interviews and deliver education, it opened up the opportunity to possibly introduce a more enhanced way of communication, especially for those unable to attend in-person diabetes teaching classes. Previous literature has shown that increased uses of technological interventions, especially web-based interventions, were associated with greater improvements in outcomes, such as significantly decreased HbA1c, decreased postprandial glucose levels, and improved diabetes

control. On the other hand, technology-assisted efforts may or may not lead to better patient experiences or improved clinical outcomes, relative to non-technology-based interventions.[10]

Understandably, more research needs to be done to examine how effective these web-based education resources are, and if they are worth the time and energy to implement. There are a vast majority of patients with diabetes who lack the resources needed to effectively manage their disease. For example, people who live in rural communities are less able to attend in-person diabetes teaching classes, however, that doesn't make them any less motivated to take charge of their life-long disease.

Conclusion

Although the remote diabetes education session did not elicit a statistically significant change in test scores, weight, or HbA1c, it did highlight potential areas for further study. According to the CDC, in the last 20 years, the number of adults diagnosed with diabetes has more than doubled as the American population has aged and become more overweight or obese.[2] This study examined the changes in knowledge, beliefs, and behaviors of a rural population after having completed a remote diabetes education session over the telephone. This population posed a nutritional need as they are unable to attend in-person diabetes education classes offered at UHS. The most common themes for barriers related to exercise and dietary change were "working long hours" and "physical limitation", e.g. obesity.

Previous literature has shown that increased use of technological interventions, especially web-based interventions, were associated with greater improvements in outcomes,

such as significantly decreased HbA1c, decreased postprandial glucose levels, and improved diabetes control.[10] Further research is needed to examine how effective these web-based education resources are as there is clearly a population need.

References

1. Friedell, G., Joyner, I. The Great Diabetes Epidemic. National Women's Health Network. March 27, 2015. Accessed February 4, 2022. https://nwhn.org/the-great-diabetes-epidemic/#:~:text=In%201994%2C%20the%20head%20of,a%20major%20public%20health%20problem.

2. Diabetes. The Big Picture. Centers for Disease Control and Prevention. December 17, 2021. Accessed February 4, 2022. https://www.cdc.gov/diabetes/basics/quick-facts.html#:~:text=Type%202%20diabetes%20accounts%20for,become%20more%20overweight%20or%20obese.

3. Pal, K., Dack, C., Ross, J., et al. Digital health interventions for adults with type 2 diabetes: qualitative study of patient perspectives on diabetes self-management education and support. *Journal of Medical Internet Research*. 2918 February; 20(2): e40. doi: 10.2196/jmir.8439.

4. Diabetes Self-Management Education and Support (DSMES) Toolkit. Background. Centers for Disease Control and Prevention. December 21,2021. Accessed February 8, 2022. https://www.cdc.gov/diabetes/dsmes-toolkit/background/background.html

5. Powers, M., Bardsley, J., Cypress, M., et al. Diabetes self-management education and support in type 2 diabetes: A joint position statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *Clinical Diabetes*. 2016 April 34(2): 70-80. doi: 10.2337/diaclin.34.2.70.

6. Davies, M., D'Alessio, D., Fradkin, J., et al. Management of hyperglycemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the study of Diabetes (EASD). *Diabetes Care.* 2018 December; 41(12): 2669-2701. doi: 10.2337/dci18-0033.

7. Self-Management Education: Learn More. Feel Better. Managing Diabetes. Centers for Disease Control and Prevention. December 18, 2018. Accessed February 8, 2022. https://www.cdc.gov/learnmorefeelbetter/programs/diabetes.htm

8. What is Telehealth> Health Resources & Services Administration. September 2021. Accessed February 9, 2022. https://www.hrsa.gov/rural-health/telehealth/what-is-telehealth

9. Adult Learning Theories and Principles. Western Governors University. Updated April 7, 2020. Accessed March 30, 2022. https://www.wgu.edu/blog/adult-learning-theories-principles2004.html.

Appendix

Questionnaire Assessing Diabetes Knowledge, Management, Complications, and Lifestyle

1. How knowledgeable do you feel about using diet and lifestyle to better control your diabetes?

    A. Not knowledgeable at all
    B. Somewhat knowledgeable
    C. Knowledgeable
    D. Very knowledgeable

2. How confident do you feel in your ability to use diet and lifestyle to better control your diabetes?

    A. Not confident at all
    B. Somewhat confident
    C. Confident
    D. Very confident

3. How important is it to you to use diet and lifestyle to better control your diabetes?

    A. Not at all important
    B. Somewhat important
    C. Important
    D. Very important

4. Which food will raise your blood sugar more, according to the glycemic index?
The glycemic index is a system of assigning a number to carbohydrate-containing foods according to how much each food increases blood sugar.

    A. roasted potato
    B. whole wheat bread
    C. a banana
    D. pizza

5. Which food will raise your blood sugar the least, according to the glycemic index?

    A. broccoli
    B. peas
    C. brown rice
    D. grapes

6. Regular exercise will increase the need for insulin or other diabetic medication.

A. Yes
B. No
C. I don't know

7. Frequent urination and thirst are signs of low blood sugar?

A. Yes
B. No
C. I don't know

8. Select the following breakfast combination that has 4 servings of a carbohydrate.

A. 2 medium pancakes, 4T maple syrup, 1 medium banana, 1 cup of milk
B. 4oz scrambled eggs, 2 pieces of bacon, 2 pieces of sausage, 1 cup of milk
C. ½ cup of oatmeal, 1T peanut butter, 1 cup of berries, 6oz yogurt (low sugar), 1 cup of milk

9. The following are considered "starchy vegetables".

A. broccoli, Brussels sprouts, mushrooms
B. corn, baked potato, peas
C. cauliflower, green beans, zucchini

10. Identify any barriers you might have related to exercise and dietary change.

11. How likely are you to consider starting an exercise regimen to help improve your health and blood sugar control?

A. very likely
B. likely
C. unsure
D. unlikely
E. very unlikely

12. Please explain the Diabetes Plate Method to the best of your ability?

13. How frequently do you use the Diabetes Plate Method to plan your meals?

A. a few times per month

B. a few times per week
C. daily
D. every meal

14. Diabetes, if not treated:

A. can lead to eye problems.
B. can lead to kidney problems.
C. can lead to foot ulcers.
D. can lead to heart problems.
E. all of the above.

The 24-Hour Dietary Recall will be used to assess for changes in eating patterns and the addition of healthier meal/snack options.

24-Hour Dietary Recall – Note: This section will be completed over the phone. The primary researcher will fill in the table below while gathering a 24-hour recall from each participant via phone.

Participant Number ___

What did the participant eat and drink in the last 24 hours?

Food and beverage consumed. Describe in detail. List one food per line.	Amount Eaten	Preparation Method	Meal Type

SUNY Oneonta Community Health Intervention Project

Diabetes Education Worksheet

Objective: to improve your knowledge, beliefs, and behaviors towards ways to optimize blood sugar control via diet and exercise.

Diabetes: a disease that occurs when your blood glucose, also called blood sugar, is too high.

*Blood glucose is your main source of energy and comes from the food you eat. Insulin, a hormone made by the pancreas, helps glucose from food get into your cells to be used for energy. Sometimes your body doesn't make enough, or any, insulin or doesn't use insulin well. Glucose then stays in your blood and doesn't reach your cells (high blood sugar).

There are many practices to help people control and monitor their carbohydrate intake. The methods that will be discussed in this education include:
carbohydrate counting, the Diabetes Plate Method, and exercise.

Foods with carbohydrates make your blood sugar go up ⇧

What foods have carbohydrates?

Grains, fruit, starchy vegetables, snack foods, dairy, sweets and desserts.

Carbohydrate Counting

(Most beneficial for those using mealtime insulin)

General carbohydrate needs:

Women	3-4 carb servings per meal
Men	4-5 carb servings per meal

*1-2 servings of a carb per snack

15g of carbohydrate = 1 carb serving

The following foods have 15 grams carbohydrate each:

Grains • 1 slice of bread (1ounce) • 1 small tortilla (6-inch size) • ¼ large bagel (1 ounce) • 1/3 cup of pasta or rice (cooked) • ½ hamburger or hot dog bun • ½ cup cooked cereal • ½ to ¾ cup ready-to-eat cereal • 2 taco shells (5-inch size)	**Fruit** • 1 small fresh fruit (3/4 to 1 cup) • ½ medium banana • 17 small grapes • 1 cup melon or berries • ½ cup canned or frozen fruit • 2 tablespoons dried fruit (blueberries, cherries, cranberries, raisins • ½ cup unsweetened fruit juice
Starchy Vegetables • ½ cup cooked beans, peas, corn, potatoes/sweet potatoes • ¼ large baked potato (3 ounces) • 1 cup acorn or butternut squash	**Snack Foods** • 3 to 6 crackers • 8 potato chips or 13 tortilla chips • 3 cups popped popcorn
Dairy • ¾ cup (6 ounces) nonfat plain yogurt, or yogurt with sugar-free sweetener • 1 cup milk • 1 cup plain rice, soy, coconut or flavored almond milk	**Sweets and Desserts** • ½ cup ice cream or frozen yogurt • 1 tablespoon jam, jelly, pancake syrup, table sugar, or honey • 2 tablespoons light pancake syrup • 1 inch square of frosted cake or 2 inch square of unfrosted cake • 2 small cookies or ¼ large cookie

Foods without Carbohydrates

Not all foods contain carbohydrates. Meat, some dairy, fats, non-starchy vegetables, and many beverages don't contain carbohydrate. So when you count carbohydrates, you can generally exclude chicken, pork, beef, fish, seafood, eggs, tofu, cheese, butter, sour cream, avocado, nuts, seeds, olives, mayonnaise, water, black coffee, unsweetened tea, and zero-calorie drinks.

The Diabetes Plate Method

(Easiest way to create healthy meals)

The Diabetes Plate Method is a way to create perfectly portioned meals with a healthy balance of vegetables, protein, and carbohydrates- without any counting, calculating, weighing, or measuring. All you need is a plate (preferably 9 inches across).

1. Fill half of your plate with non-starchy vegetables as they are lower in carbohydrates and don't raise your blood sugar very much.

Examples of non-starchy vegetables: asparagus, broccoli, cauliflower, Brussels sprouts, carrots, mushrooms, green beans, peppers and tomatoes.

2. Fill one quarter of your plate with lean protein foods. Of note, some plant-based protein foods, like beans and legumes, are also high in carbohydrates.

Examples of lean protein foods: chicken, turkey, eggs, salmon, tuna, shrimp, cheese, cottage cheese, lean pork cuts such as center loin chop or tenderloin and lean beef cuts such as chuck, round, sirloin, tenderloin.
Plant-based sources of protein: beans, lentils, hummus, falafel, nuts, butters, edamame, tofu.

3. Fill one quarter of your plate with carbohydrate foods. These foods have the greatest effect on blood sugar.

Examples of carbohydrate foods: brown rice, oatmeal, popcorn, bread, pasta, tortilla, beans, fruits, dairy products like milk, yogurt and milk substitutes, and starchy vegetables such as butternut squash, green peas, potato/sweet potatoes.

4. Choose water or a low-calorie drink. Water is the best choice because it contains no calories or carbohydrates and has no effect on blood sugar.

Zero- or low- calorie drinks options include: unsweetened tea (hot or iced), unsweetened coffee (hot or iced), sparkling water/club soda, flavored water or sparkling water without added sugar, diet soda or other diet drinks.

What about combination foods? soups, casseroles, sandwiches, pizza, pasta, etc.

- You can still use the plate method when preparing and portioning combination foods. Just identify the different foods in the dish and think about where they would fit in the plate.

Diabetes and Exercise

Along with your diet and medications, regular physical activity is an important part of managing diabetes. Why? Exercise lowers blood glucose levels and boosts your body's sensitivity to insulin.

*If you haven't been physically active and are worried about your health, it's important to consult your doctor and start slowly.

Current recommendations: to get **150** minutes of exercise per week (spread it out- 50 minutes 3 times a week, 30 minutes 5 times a week or 25 minutes 6 times a week).

Examples of exercise include: walking, cycling, swimming, weightlifting, resistance band exercises, cleaning, dancing, and playing with your dog.

- You may need to check your blood sugar before your workout- if lower than 100 mg/dL, eat a small snack containing 15-30 grams of carbohydrates (fruit juice, whole fruit, crackers)
- The best time to exercise is one to three hours after eating, when your blood sugar level is likely to be higher
- 10 minutes of exercise three times a day gives you the same benefit as 30 minutes at one time
- Have fun- invite a friend, listen to music, join a class
- Set goals

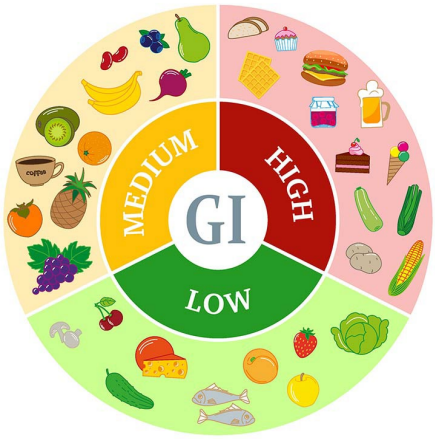
Added benefits: Being active reduces your risk for heart disease, promotes lower blood pressure, contributes to weight loss (if needed), improves your mental health, improves your cholesterol, helps you sleep better, and can lower your hemoglobin A1c (HbA1c).

Important considerations:

1. Wear cotton socks and athletic shoes that fit well.
2. After being physically active, check your feet for sores, blisters, irritation, cuts, or other injuries.
3. After your activity, check to see how it has affected your blood glucose level.

Signs of hypoglycemia (low blood sugar)	**Signs of hyperglycemia (high blood sugar)**
Fast heartbeat	Thirst
Hunger	Frequent peeing
Shakiness	Shortness of breath
Anxiety	Dry mouth
Sweating	Blurry vision
Irritability	Weight loss
Headache	**Headache**
Fatigue	**Fatigue**
Confusion	**Confusion**

The Glycemic Index



The glycemic index (GI) is a measure of how quickly a food causes our blood sugar levels to rise using a scale of 0-100

Foods with a low GI are digested and absorbed at a slower rate, causing a slower rise in blood sugar levels. These are typically rich in fiber, protein and/or fat.

Foods with a higher glycemic index (GI) are quickly digested and absorbed, causing rapid rise in blood sugar. Most often these foods are high in processed carbohydrates and sugars.

Low glycemic index foods with a number of 50 or less	**High glycemic foods index foods with a number over 70**
• Vegetables: Peppers, broccoli, tomatoes, lettuce, eggplants • Fruits: strawberries, apples, pears • Legumes: chickpeas, beans, legumes • Dairy: whole/full-fat milk, plain yogurt • Sweets: dark chocolate with more than 70% cocoa • Nuts: cashews, peanuts	• Processed foods: corn chips, pretzels • Sugar-containing beverages: soda, sweet tea, sports drinks • Fast food: cheeseburgers, fried chicken, pizza • Bakery/grains: doughnuts, white bread, cereal (unless whole grain) • Potatoes: mashed potatoes, French fries.